Human Decision-Making Under Uncertainty in the Upstream Oil and Gas Industry

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ABSTRACT

Business under-performance in the upstream oil and gas industry, and the failure of many decisions to return anticipated results, has led to a growing interest over the past few years in understanding the impacts of current decision-making tools and processes and their relationship with decision outcomes. Improving oil and gas decision-making is thus, increasingly, seen as reliant on an understanding of what types of decisions are involved and how they actually are made in the "real world".

There has been significant work carried out within the discipline of cognitive psychology, observing how people actually make decisions. However, little is known as to whether these general observations apply to decision-making in the upstream oil and gas industry. Nor has there been work on how the results might be used to improve decision-making in the industry.

This research is a step towards filling this gap by developing two themes – decision-making process and decision type. It distils a "real world" oil and gas decision-making model together with a theoretical decision-making model. Comparing and contrasting the two models yields several prescriptions for improved decision-making in the upstream oil and gas industry.

This research also documents the development of an oil and gas decision-making taxonomy that lays a decision space within which to judge the processes of decision-making. The taxonomy builds on established ideas in the human decision-making literature, but is itself novel, and involves four different dimensions: 1) complexity; 2) task constraint; 3) value functions; and 4) structure of the information environment.

A primary observation is that decision-making processes are tailored to the various types of decisions. It is argued that maximising the chances of a good outcome in "real world" decisions requires the implementation of such tailoring.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

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Steven I Mackie Date

Acknowledgements

Whilst the work documented in this thesis is my own – and I take full responsibility for it – it certainly did not come into being without the help and support of many others. I would, therefore, like to take the opportunity to thank those who contributed.

First, recognition needs to go to my supervisors, Prof. Steve Begg, Dr. Chris Smith and Dr. Matthew Welsh. Each contributed in their own unique way. The work crosses several faculty and school boundaries (School of Petroleum, Graduate School of Management and School of Psychology) and thus allows for marvellous opportunities – all new ideas come at the boundaries. It also requires dedicated effort from the people to break through the silos. Funding for the research comes from an Australian Research Council grant (ARC linkage LP0453894). This is financially supported by BHPBilliton and Santos. Appreciation must go to them. The grant was obtained by submission from Prof. Begg, Prof. Reidar Bratvold (University of Stavanger) and Assoc. Prof. Michael Lee (University of California – Irvine) – thanks. The research also called for volunteer participants in several rounds of interviews. In an industry that is already stretched with limited resources, the fact that these people gave their time and ideas willingly speaks volumes. Due to confidentiality it is impossible to thank them all individually, which is what I would like to do, but must settle for a general: "Thanks Guys!" I especially appreciated the candid comments and suggestions of my examiners.

Now to the motivators and finishers. My late mother always pined "one day I would like a doctor in the house." Mum this is for you. Finally, and by far the most important, thanks must go to Violet, who not only supported me through the entire ordeal but was the greatest sounding board, editor and finisher!! She has to be the best eternal companion anyone could ask and pray for – someone of like thought and aspiration.

Professor Higgins was wrong!

You have got to let a woman in your life[1] to be successful!!

To the two women in my life –

Violet – my eternal companion

Norma – my mother

[1] Taken from George Bernard Shaw's 1913 play, Pygmalion

Presentations and Papers

The research project has generated the following presentations and papers.

PRESENTATIONS (in reverse chronological order)

1. **Decision Type: A Key to Realizing the Potential of Decision-Making Under Uncertainty**, presented at the Australian Petroleum Production and Exploration Association annual conference, April 2007
2. **Human Decision-Making in the Upstream Oil and Gas Industry,** presented at the Annual General Meeting of the Petroleum Exploration Society of Australia (SA Branch), March 2007
3. **PhD Progress Presentation – Year End 2006 Status Report**, presented to BHPBilliton (PhD sponsors via ARC Linkage Grant), November 2006
4. **Realizing the Potential of Decision-Making Under Uncertainty**, presented at the American Association of Petroleum Geologists International Conference, November 2006
5. **An Oil and Gas Decision-Making Taxonomy,** presented at the Society of Petroleum Engineers Asia Pacific Oil and Gas Conference and Exhibition, June 2006
6. **PhD Progress Presentation – Year End 2005 Status Report**, presented to Santos (Ph.D. sponsors via ARC Linkage Grant), February 2006
7. **Would You Know A Good Decision If You Saw One?,** Presented to Santos (PhD sponsors via ARC Linkage Grant), August 2005
8. **Human Decision-Making in the Oil and Gas Industry,** presented at the Centre for Improved Business Performance, Australian School of Petroleum, University of Adelaide, March 2005
9. **Group Heuristics and Biases**, presented at the Centre for Improved Business Performance, Australian School of Petroleum, University of Adelaide, February 2005

PAPERS (Appendix 1)

1. **Mackie, S.I., Welsh, M.B. and Lee, M.D.**, 2006, An Oil and Gas Decision-Making Taxonomy, SPE paper 100699.
2. **Mackie, S.I., Begg, S.H., Smith, C.S., and Welsh, M.E.**, 2007, Decision Type: A Key to Realizing the Potential of Decision-Making Under Uncertainty, *AAPEA Journal*, Volume 22, Number 1, pp 307 – 317. Won Best Paper Award.